



Outline for a Puget Sound Water Quality Monitoring Program

Puget Sound Science Panel – June 19, 2008
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What the memo presents:

- a discussion of the scope of “water quality” as an issue identified by the PSP,
- a recommended systematic approach to building a water quality monitoring program based on the foundation of hypotheses testing,
- some considerations for addressing issues of spatial scale,
- an initial (incomplete) review of ongoing monitoring efforts that could help focus program scope;
- an example that shows how assessment questions could be described for one dimension of water quality (namely, contaminants).

Desired outcomes:

- Presentation of a stepwise approach for developing a monitoring program
- Your buy-off on the approach or suggestion of alternatives
- Resolution of the need for clear statement of monitoring objectives

A holistic view of water quality

- It isn't just about chemicals
- Water Resource Integrity integrates physical, biological, chemical processes and ecological functions
- Includes physical habitats, water quantity, chemical constituents, and ecological support of biotic communities and species
- The concept is well grounded in ecological literature and in case law

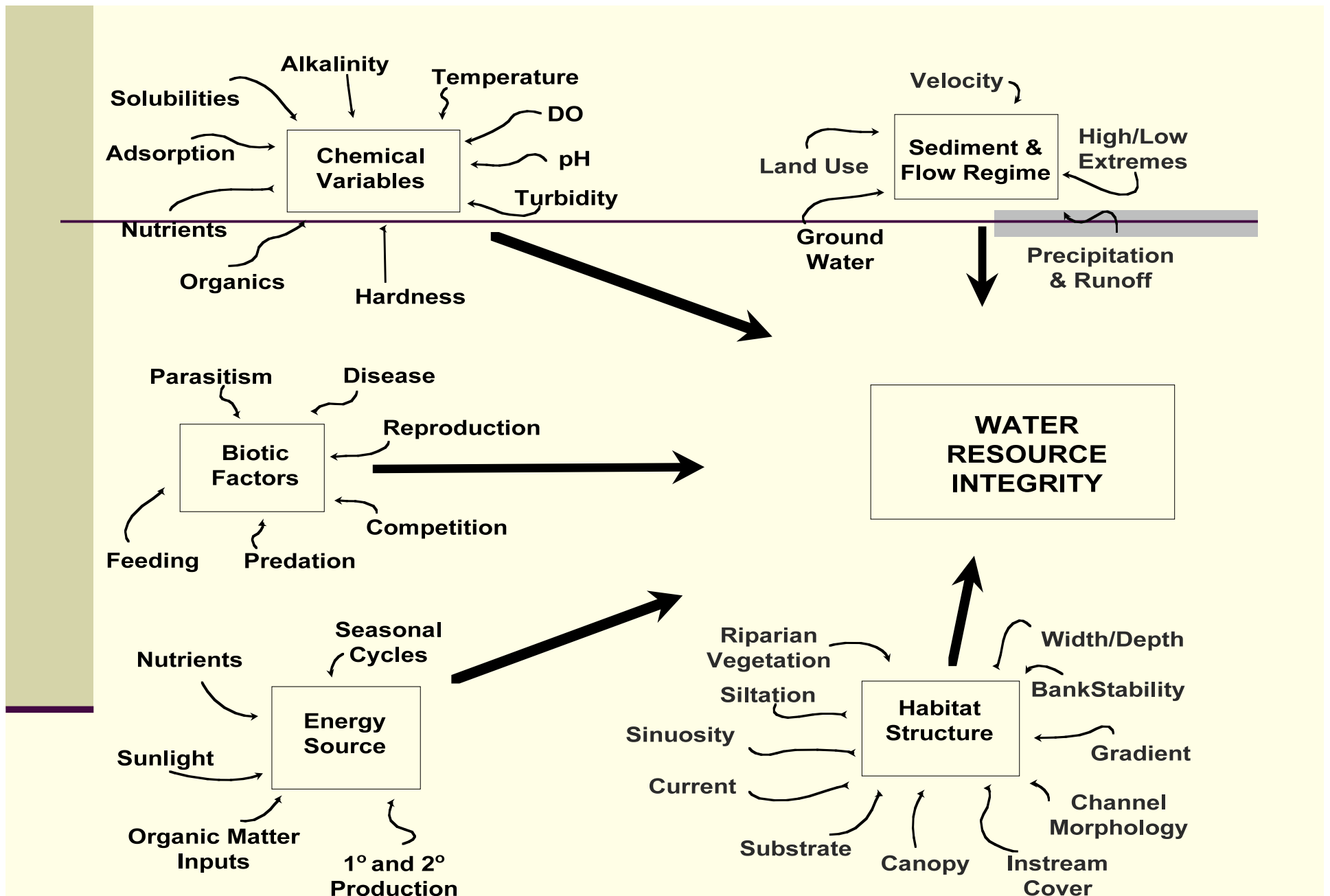


Figure 1. Water resource integrity (Adapted from Yoder 1995; from Bauer and Ralph 1999).

Use what we have:

- *“Biologists are rather better at reinventing wheels than most scientists! We publish more and longer papers, so older seminal ideas, like fossils in geological strata, tend to become quickly buried out of sight.” H. B. N. Hynes (1994)*

We lack a common knowledge base

- There is no current and comprehensive, searchable library of relevant information about Puget Sound
- We need to know that foundation of knowledge to build upon
- We need to know the key gaps and develop a plan to resolve them

We lack a common assessment framework

- There are many laudable and even useful monitoring efforts, but there is no agreed upon set of objectives to ensure alignment of purpose and outcome
- Many do not have a clear statement of how they inform management decisions
- Some suffer from poor study design including few with testable hypotheses

Hypotheses*

- An unproved theory, proposition, supposition, etc. tentatively accepted to explain certain facts or to provide a basis for further investigations
- Can be derived from clear objectives, assessment questions, assumptions and other means

Focus on Status & Trends

- Initial focus to demonstrate capability
- S&T monitoring provides reference and baseline conditions
- Not explicitly linked to management decisions or effective strategies
- Provides context to consider cause/effect relationships

Focus on Status & Trends

“In the absence of reference points against which to compare monitoring results, the magnitude of change and significance of trends cannot be evaluated.”

Reference points are often chosen to depict "natural" conditions, but can also include minimally disturbed, best attainable or most degraded (worst-case) sites, depending on the nature of the monitoring questions.”

IMST Report (2007)

Key questions in indicator monitoring framework design:

Is the goal of monitoring simply to track *status and trends* of ecosystem features (**descriptive**), or is it to evaluate ecosystem responses to particular management actions (**adaptive**) or stressors through comparison with benchmarks? (IMST 2007)

1. Identify goals for Puget Sound recovery

2. Identify questions and assumptions, and thus *hypotheses*, about how Puget Sound 'works'

3. Identify management issues, objectives and strategies

4. Identify **data needed to test hypotheses** and sort by status, trends, diagnosis, treatment and effectiveness

5. Define a statistically robust **study design** that includes indicators, measurement tools assign spatial and temporal scale of effort; & provides reliable results within defined timeframe

6. Initiate pilot sampling program and analyze data to confirm relevance to assessment questions – expand as appropriate

7. Convey results to decision makers



Step 2: Identify questions, assumptions and hypotheses about PS

- The key step of recognizing assumptions and defining hypotheses about the nature, dynamic characteristics, and causal relationships of the Puget Sound ecosystem.
- This is the most critical component of the process, in that it requires an articulation of the questions that need to be answered through monitoring.

Step 3: Identify issues & objectives

- **Step 3** requires identification of “management issues,” and subordinate objectives that allow us to define a strategy to address specific components of the issue. These have not yet been clearly defined
- While topic forums may provide characterization of issues, they were not designed to detail any management objectives derived from testable hypotheses.

Steps 4 & 5: Identify data needs and monitoring design details

- **Step 4** takes the working hypotheses from **Step 2**, links them to the management issues in **Step 3**, and identifies data needs and the type(s) of monitoring most appropriate to address those needs.
- In **Step 5**, the details of the monitoring design would be defined, as linked to the question to be addressed; includes measurement tools, spatial and temporal scale, and appropriate indicators and “significant” change.

E.g. PSP objectives:

Significantly **reduce toxics** entering Puget Sound fresh and marine waters

Significantly **reduce nutrients and pathogens** entering Puget Sound fresh and marine water

Manage **storm water runoff** to improve water quality and habitat (by addressing water quantity and chemical pollutant pathways and constituents)

Status - What are conditions of water quality throughout Puget Sound?

Ho: Water quality, as measured by toxic chemical constituents, is degraded and will continue to degrade, and thus presents a persistent risk to the Puget Sound ecosystem.

Ho: In particular locations in the system, primary and tertiary vertebrate consumers in the Puget Sound food chain are exhibiting increasing levels of organic contaminants sufficient to cause lesions and other immunological effects.

Ho: Water quality, as measured by the levels of nutrients and pathogens is deteriorating in certain locations to the point that species diversity is being negatively affected.